

## The effect of cutaneous candidiasis toward skin moisture in Haji Adam Malik Central Hospital in Medan



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### ABSTRACT

**Background:** Cutaneous candidiasis is the second most common fungal infection. One of the predisposing factors for candidiasis is moisture. Excess moisture will cause skin damage related to skin moisture or also known as Moisture-Associated Skin Damage (MASD) is defined as inflammation and erosion of the skin caused by prolonged exposure to various sources of moisture. This study aimed to determine the comparison of skin moisture in patients with cutaneous candidiasis and without cutaneous candidiasis.

**Subjects and Methods:** This study was an observational analytic test with a cross sectional approach on 32 subjects with cutaneous candidiasis and 32 subjects without cutaneous candidiasis. The diagnosis was confirmed by clinical examination, skin scraping with 10% KOH and fungal culture. Check skin moisture using a scalar moisture checker on the volar lower arm.

**Results:** The majority of the subjects' age ranged from 40-49 years (28.1%). The majority of gender is female (62.5%). The majority of body mass index is overweight (46.9%). The majority of occupations are service and sales personnel consisting of traders and employees (43,8%). The majority have middle education level is senior high school/equivalent (43.7%). Distribution of cutaneous candidiasis by location. Majority was intertriginous candidiasis (50.0%). The degree of skin moisture in candidiasis subjects was wet as many as 19 people (59.4%) and subjects without candidiasis were normal as many as 21 people (65.6%). Humidity in cutaneous candidiasis subjects compared with subjects without cutaneous candidiasis showed a significant difference ( $p = 0.001$ ).

**Conclusion:** Subjects with cutaneous candidiasis had a wetter level of skin moisture than subjects without cutaneous candidiasis.

**Keywords:** *cutaneous candidiasis, scalar moisture checker, skin moisture.*

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### BACKGROUND

Cutaneous candidiasis is a fungal infection disease caused by *Candida* species localized to the skin that appear as thick red patches and plaques with satellite lesions in the form of papules and pustules around them.<sup>1-6</sup> Cutaneous candidiasis often affects the intertriginous areas, especially the axillae, under the breasts, and groin.<sup>4,7</sup> Candidiasis is found worldwide, can affect all ages, both men and women.<sup>8-10</sup>

Temperature and humidity are important predisposing factors for the growth of candidiasis on the skin.<sup>6</sup> So that the prevalence of cutaneous candidiasis increases in hot and humid climates as well as in a wet and humid work environment.<sup>5,9</sup> The current study has explained how excess moisture can cause skin damage

and increase the skin's incidence of secondary fungal infections.<sup>6,11-13</sup> Skin moisture is a skin condition that is affected by water content in the skin as a result of environmental changes, use of drugs, increased certain age or disease.<sup>11-15</sup>

*Moisture-Associated Skin Damage* (MASD) is defined as inflammation and erosion of the skin caused by prolonged exposure to various sources of moisture, such as urine, feces, sweat, wound exudates, mucus, or saliva.<sup>13</sup> Excessive skin exposure to moisture can disrupt the integrity of the barrier, disrupting the complex molecular arrangements of intercellular lipids in the stratum corneum and the connections between corneocyte cells in the epidermis. Once damaged, the skin becomes more permeable and

susceptible to penetration of irritants, leading to inflammation, dermatitis, and fungal/bacterial skin infections.<sup>13,14</sup>

In a study conducted by Mackenzie it was found that *Candida* could maintain about 50% of blastospores at a relative humidity of 60%, and blastospore survival increased with an increase in relative humidity.<sup>11</sup> Furthermore, research conducted by Kashbur et al found that there was an increase of  $10^3$ - $10^4$  blastospores until the fifth day of inoculation in a moist environment, while in a dry environment less than 1% survived in the first 1 hour.<sup>16</sup> This study aimed to determine the comparison of skin moisture in patients with cutaneous candidiasis and without cutaneous candidiasis.

**Table 1. Distribution of Cutaneous Candidiasis Patients by Subject Characteristic**

Variable	Cutaneous candidiasis (n=32)		Non-Cutaneous candidiasis (n=32)	
	n (%)	Mean ± SD	n (%)	Mean ± SD
<b>Age (years)</b>				
20-29	6 (18.8)	42.68±14.54	6 (18.8)	42.68±14.54
30-39	8 (25.0)		8 (25.0)	
40-49	9 (28.1)		9 (28.1)	
50-59	4 (12.5)		4 (12.5)	
60-69	4 (12.5)		4 (12.5)	
70-79	1 (3.1)		1 (3.1)	
<b>Gender</b>				
Male	12 (37.5)	-	12 (37.5)	-
Female	20 (62.5)		20 (62.5)	
<b>BMI</b>				
Normal	12 (37.5)	26.48±4.17	17 (53.1)	25.45±3.39
Overweight	15 (46.9)		12 (37.5)	
Obese grade I	4 (12.5)		3 (9.4)	
Obese grade II	1 (3.1)		0 (0.0)	
<b>Occupation</b>				
Professional	5 (15.6)		12 (37.5)	
Service and sales business	14 (43.8)		11 (34.4)	
Skilled workers in agriculture, forestry & fisheries	2 (6.3)		1 (3.1)	
Manual labor	4 (12.5)		5 (15.6)	
Unemployed	7 (21.8)		3 (9.4)	
<b>Education Level</b>				
Low	7 (21.9)		8 (25)	
Middle	14 (43.7)		3 (9.4)	
High	11 (34.4)		21 (65.6)	

## METHODS

This research was conducted from December 2020 to July 2021 at the Department of Dermatology and Venereology at the Haji Adam Malik Central Hospital in Medan. This study is an observational analytic study with candidiasis cutis aged >18 years. The control group in this study were subjects who did not suffer from cutaneous candidiasis and had previously been matched with the case group. Patients and controls who were using moisturizers ≤7 days previously, had dermatoses that affect skin moisture such as ichthyosis, psoriasis, atopic dermatitis, and diseases that can cause xerosis, used oral drugs that affect skin moisture such as clofazimine, isotretinoin, class statins, and cimetidine as well as those taking oral and topical antifungal drugs were excluded from this study. The humidity measuring instrument used in this research is the

Scalar Moisture Checker type MY 808 S which has humidity measurement results in the form of dry <37%, normal 37-45% and wet >45%.

Subjects who had been diagnosed with cutaneous candidiasis through anamnesis, physical examination, and supporting examinations in the form of skin scrapings with 10% KOH and fungal culture were examined for skin moisture using a Scalar Moisture Checker by attaching the device to the inside of the right arm. To equalize the conditions, all research subjects were rested 10 to 20 minutes before measurement and carried out in a room with a temperature of  $21 \pm 1^\circ\text{C}$  according to the relative humidity temperature. The data that has been collected is then processed using statistical analysis of the chi square test, if the expected count value is more than 20% followed by the Kruskal Wallis test.

## RESULTS

In this study, it was found that the majority of the age range of the research subjects with cutaneous candidiasis was in the 40-49 year age group (28.1%) followed by the 30-39 (25%) and 20-29 (18.8%) age group with a mean of  $42.68 \pm 14.54$ . Similar results were obtained in study subjects without cutaneous candidiasis. Gender distribution in subjects with cutaneous candidiasis was predominantly female (62.5%) followed by male sex (37.5%), then in subjects without cutaneous candidiasis, similar results were obtained. The distribution of BMI of subjects with cutaneous candidiasis was mostly overweight (46.9%) followed by normal (37.5%), grade I obesity (12.5%) and at least grade II obesity (3.1%). the mean BMI in subjects with cutaneous candidiasis was  $26.48 \pm 4.17$ . Meanwhile, in the group of subjects without cutaneous candidiasis, the majority of BMI was found

**Table 2. Distribution of Cutaneous Candidiasis Patients by Location**

Location	n	(%)
Cutaneous Candidiasis	4	11,2
Intertriginous Candidiasis	18	50,0
Interdigital Candidiasis	10	27,8
Onychomycosis Candidiasis	2	5,5
Paronychia Candidiasis	2	5,5
<b>Total</b>	<b>36</b>	<b>100,0</b>

**Table 3. Degree and comparison of skin moisture in cutaneous candidiasis patients and those without cutaneous candidiasis.**

Degree of skin moisture	Cutaneous candidiasis (n=32)		Non-Cutaneous candidiasis (n=32)		p-value
	n	(%)	n	(%)	
Dry	2	6.2	5	15.6	0,001
Normal	11	34.4	21	65.6	
Wet	19	59.4	6	18.8	

in the normal group (53.1%) followed by overweight (37.5%), and finally obesity grade I (9.4%), with an average number of 25.45±3, 39.

The demographic characteristics of the subjects' occupations which were grouped based on the 2014 Indonesian Standard Position Classification (KBJI) by the Ministry of Manpower and BPS.<sup>17</sup> It was found that the majority of the occupational groups of subjects suffering from candidiasis cutis were service and sales business personnel (43.8%) consisting of traders and employees, followed by the unemployed group (21.8%) consisting of housewives, retirees and students, then the professional group (15.6%) consisting of teachers and nurses. In subjects who did not suffer from cutaneous candidiasis, the majority of the occupational groups were professionals (37.5%) consisting of nurses and doctors, followed by the service and sales business personnel (34.4%) consisting of traders and employees, then followed by manual labor group (15.6%) consisting of laborers

The classification of education levels is based on the RI Law Number 20 of 2003 concerning the national education system.<sup>18</sup> It was found that the majority of subjects with candidiasis cutis had a

secondary education level (senior high school/equivalent) (43.7%) followed by higher education (diploma/bachelor/master/specialist/doctoral) (34.4%) and basic education (elementary school/junior high school/equivalent) (21.9%). Then the subjects without cutaneous candidiasis had the majority of higher education (bachelor/master/specialist/doctoral) (65.6%) followed by basic education (elementary school/junior high school/equivalent) (25%) and secondary education (senior high school/equivalent) (9.4%)

Then in this study the results obtained were the majority of cutaneous candidiasis based on location, namely intertriginous candidiasis (50.0%), then interdigital candidiasis (27.8%), cutaneous candidiasis (11.2%), candida onychomycosis (5.5%) and candida paronychia (5.5%). Some subjects had more than 1 type of candidiasis based on the affected location, resulting in 36 types of cutaneous candidiasis (Table 2).

After the data was collected, a chi square test was performed but the expected count value was more than 20% (33.3%) so that it was continued with the Kruskal Wallis test. Table 3 shows that the majority of humidity levels in subjects with cutaneous

candidiasis were wet (59.4%) followed by normal (34.4%) and dry (6.2%). Meanwhile, in patients without cutaneous candidiasis, the majority of the subjects' humidity was normal (65.6%) followed by wet (18.8%) and dry (15.6%). Then the p-value is 0.001 so it can be concluded that there is a significant comparison of skin moisture between the group of subjects with cutaneous candidiasis and subjects without cutaneous candidiasis.

## DISCUSSION

Cutaneous candidiasis is the most common *Candida* fungal infection affecting geriatrics and newborn, this is associated with lower immunity in these groups.<sup>19</sup> However, it is said that cutaneous candidiasis can occur in all age ranges, depending on the patient's predisposing factors.<sup>8</sup> In this study, it was found that the most age group of patients with cutaneous candidiasis was the age group of 40-49 years as much as 28.1%.

The prevalence of cutaneous candidiasis by gender is mostly female (62.4%), although cutaneous candidiasis can affect both men and women.<sup>3-5,7-10</sup> In this study, the majority of subjects were female (62.5%). which is in agreement with many other studies. Mahmoudabadi in Pakistan was obtained from 257 subjects with cutaneous candidiasis with the majority being female (69.6%).<sup>20</sup> Similar results were presented in a study by Ghasemi et al in Theran, Iran where 59.3% of the 290 cutaneous candidiasis subjects were female.<sup>21</sup> In obesity, the body becomes sweaty and moist and there are many folds in the skin.<sup>22</sup> Obese patients sweat more because of their thick layer of subcutaneous brown fat, generating more heat than people with normal body mass.<sup>23</sup> This increase the thermal, frictional, and moisture components of the skin.<sup>24</sup> In this study, the distribution of BMI of subjects with cutaneous candidiasis was found to be overweight (46.9%) with a mean BMI value of 26.48±4.17. The results in this study are in accordance with research by Adha in Medan, Indonesia which found that the majority of subjects with cutaneous candidiasis had overweight BMI.<sup>22</sup>

The work group of service and sales personnel in this study consisted of

traders and employees. Work as a trader who is exposed to heat everyday often sweats and clothes become damp, this causes high humidity which can increase the growth of *Candida*. Furthermore, the most common occupational group is the unemployed group, the majority of which consist of housewives who are mostly susceptible to *Candida* infection, this can occur due to repeated exposure to water during household chores such as washing dishes and washing clothes.<sup>21</sup> Research by Polii et al in Manado, Indonesia found that the majority of cutaneous candidiasis subjects had jobs as employees (32.5%) and housewives (25%).<sup>25</sup> Ghasemi et al in Theran, Iran found that the majority of cutaneous candidiasis subjects had jobs as housewives (46.7%) and entrepreneurs (26.2%).<sup>21</sup> Then for the education level of the subjects in this study, the majority of subjects with cutaneous candidiasis had a secondary education level (SMA/SMK/ equivalent) (43.7%).

In this study, the results showed that the majority of cutaneous candidiasis based on location were intertriginous candidiasis (50.0%). According to research by Hasan et al in Baquba, Iraq, the most common cutaneous candidiasis found was intertriginous candidiasis (62.9%). Prof. Dr. Kandou's RD from 2009-2011 was intertriginous candidiasis (93.6%).<sup>26</sup> *Candida albicans* tends to colonize intertriginous areas that have a humid and warm local environment. In addition, intertriginous areas are also susceptible to maceration so that *Candida albicans* is easier to infect the host.<sup>3,27</sup> The tropical climate in Indonesia also contributes to causing the body, especially the intertriginous area to sweat more, so that the skin becomes hot and humid.<sup>26</sup>

This study found that the majority of humidity levels in subjects with cutaneous candidiasis were wet (59.4%), while in patients without cutaneous candidiasis, the majority of subjects' humidity was normal (65.6%). It was concluded that there was a significant comparison of skin moisture between the group of subjects with cutaneous candidiasis and subjects without cutaneous candidiasis ( $p < 0.05$ ).

This study is in accordance with the theory regarding the appearance of

cutaneous candidiasis associated with humidity. One of the predisposing factors for candidiasis is excessive moisture, which can cause skin damage and increase the appearance of secondary infections by *Candida*. Inflammation and erosion that occurs in the skin as a result of prolonged exposure to various sources of moisture, such as urine, feces, sweat, wound exudates, mucus, or saliva.<sup>28</sup> Exposure of the skin to excessive environmental moisture can disrupt the integrity of the barrier, interfering with the molecular regulation of lipids between cells, cells in the stratum corneum and connections between corneocyte cells in the epidermis. As a result, the skin becomes more permeable and susceptible to penetration of irritants, leading to inflammation, dermatitis, and fungal/bacterial skin infections.

*Candida* can maintain about 50% blastospores at a relative humidity of 60%, and the survival rate of blastospores increases with the increase in relative humidity.<sup>11</sup> *Candida* can increase to  $10^3$ - $10^4$  blastospores up to the fifth day of inoculation in a moist environment, whereas in a dry environment it is less than 1% which lasts the first 1 hour.<sup>16</sup>

In this study, it was found that there was a significant comparison of skin moisture between the groups of subjects with cutaneous candidiasis and subjects without cutaneous candidiasis. This can happen because the majority of subjects with cutaneous candidiasis have wet skin moisture levels, while the majority in the group without cutaneous candidiasis have normal skin moisture. The skin moisture is a predisposing factor for the appearance of candidiasis where the current study has explained how excessive skin moisture can cause skin damage and increase the incidence of secondary fungal infections of the skin. Experts agree that secondary infection of the skin is a clinically relevant complication of MASD.<sup>29</sup> Whereas in normal-moisturized skin there is no MASD so that fungal infections are less likely to occur.

The limitation of this study is that it did not evaluate the association of confounding factors that can affect skin moisture in skin candidiasis patients.

## CONCLUSION

In conclusion, we found a significant comparison of skin moisture between the groups of subjects with cutaneous candidiasis and subjects without cutaneous candidiasis, where subjects with cutaneous candidiasis tended to have wet skin moisture compared to subjects without cutaneous candidiasis.

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## CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this article.

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## AUTHOR CONTRIBUTION

All authors have contributed to all process in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

## ETHIC APPROVAL

This research was conducted after approval from the Ethics Committee of the University of North Sumatra, North Sumatra, Indonesia with registration number 36/KEP/USU/2021.

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